Prabability:

+ It's the measure of the likehood of an event.

Ex- Prabality $= \dfrac{\text{no. of favorable out came}}{\text{Total no of passible out came}}$

Prabability for head ar tail to come in a coin when tossed.

$P(\text{Head}) = \frac{1}{2}$

$P(\text{tail}) = \frac{1}{2}$

Mutual Exclusive event.

Two events are mutual exclusive event when bath output are different ar say bath of them occurance are different.

Ex- Head and Tail can't occure once in coin at same time.

Non Mutual Exclusive event.

when bath output occurs at same time it's Non Mutual Exclusive event.

Ex- win and loss happens at same time.

Addition rule for Non- mutual exclusive event:

If A and B are non- mutual exclusive event then prabability of getting A or B is

$$\boxed{P(A \cup B) = P(A) + P(B) - P(A \cap B)}$$

$P(A \cap B) = 0$ in case of mutual exclusive.

Multiplication rule:

- Dependent events: Two events are called dependent if they effects each other.

Ex- let bag has 10 balls (3 Red, 7 Green).

If we pick any one bag probability of other will change as tatal no.s of ball will decrease.

$P(Red) = \frac{3}{10}$ [Initially 10 Balls]

$P(Green) = \frac{7}{9}$ [one red ball has taken so tatal left is 9]

Independent events: when two events do not effect one another then it's Independent events.

Ex- Probability of getting 3, 5 from dice.

Probability of getting each face in dice is equal which is $\frac{1}{6}$

Now, Probability of getting 3, 5

$$= P(3) \times P(5) = \frac{1}{6} \times \frac{1}{6} = \frac{1}{3}$$

Permutation and combination:

Permutation: Different arrangments which can be made by taking same or all of given no.s of object at a time.

Ex- Permutation of three items a, b and c taken two at a time are

ab, bc, ca, ba, cb, ac

ab and ba are considered separately

$$\boxed{\text{formulae} = {}^nP_r = \frac{n!}{(n-r)!}}$$

Combination: when same elements selected in different order are considered as same say 1 then it's combination.

$$\boxed{\text{formulae} = {}^nC_r = \frac{n!}{r!(n-r)!}}$$

Ex - As earlier ab and ba were considered separately but in combination its same.

Covariance:

It's statical tool used to determine the relationship b/w the movements of two random variables.

Positive covariance means variable are Proportional to each other vs negative covariance means they are inversly pro-portional to each other.

$$\boxed{\text{Covariance}(x, y) = \frac{\sum (x_i - \bar{x}) \cdot (y_i - \bar{y})}{N - 1}}$$

X	Y
2	5
6	10
7	12
8	13
12	15

$\bar{X} = \sum_{i=1}^{n} \frac{x_i}{n} = 7$

Similarly, $\bar{Y} = 11$

$$\text{cov}(X, Y) = \frac{(2-7)\cdot(5-11) + (6-7)\cdot(10-11) + (7-7)\cdot(12-11) + (8-7)\cdot(13-11) + (12-7)\cdot(15 - 11)}{4}$$

$$= 53/4 = 13.25$$

It's positive covariance it means X incr-
-ease then Y will also increase.

Pearson correlation coefficient.

It's linear correlation coefficient that return value b/w -1 to $+1$.

As the value of covariance can varry

extensionally and thus it's tough to work in huge range. So, restricting value within bounded range would be relevant.

Pearson correlation coefficient bound value b/w −1 to +1.

$$\boxed{\text{Pearson corr. coeff} = \frac{Cov(X, Y)}{\sigma X \; , \; \sigma Y}}$$

Considering previous value of X and Y.

X −	2, 6, 7, 8, 12	$\bar{X} = 7$
Y −	5, 10, 12, 13, 15	$\bar{Y} = 11$

$$\sigma X = \sqrt{\frac{(X_i - \bar{X})^2}{5 - 1}} = \frac{7.21}{2} = 3.63$$

$$\sigma Y = \sqrt{\frac{(Y_i - \bar{Y})^2}{5 - 1}} = \frac{7.61}{2} = 3.81$$

$$Cov(X, Y) = 13.25 \left[\begin{array}{c}\text{from previous} \\ \text{data}\end{array}\right]$$

Pearson correlation coef

$$= r = \frac{Cov(X, Y)}{\sigma_X , \sigma_Y}$$

$$= \frac{13.25}{3.63 \times 3.81}$$

$$= 0.96$$

Thus, we have bounded value b/w -1 to +1 making it easy for us to compare.

Spearman's rank correlation.

It measures strength and direction of association b/w two ranked variables.

we use it for Non linear variables.

It gives measure of monotonicity of the relation b/w two variables.

$$\boxed{r_s = \frac{cov(R(X), R(Y))}{\sigma(R(x)) \times \sigma(R(Y))}}$$

R(x) and R(Y) is simply natural no. assigned to X and Y when arranged in ascending order.

Ex − X = 2, 3, 6, 4, 7 ⇒ $\underset{X}{\text{arranged}}$ = 2, 3, 4, 6, 7

$X \rightarrow 2, 3, 4, 6, 7$
$R(X) \rightarrow 1, 2, 3, 4, 5$

Considering previous value of X and Y

X − 2, 6, 7, 8, 12	Y − 5, 10, 12, 13, 15
R(X) − 1, 2, 3, 4, 5	R(Y) − 1, 2, 3, 4, 5

Calculating $\overline{R(X)}$ and $\overline{R(Y)}$

$= 1+2+3+4+5/5 = 3$

$Cov(R(X), R(Y)) = 2.5$

$\sigma R(X) = \sigma R(Y) = 1.56$

Calculating, $r_s = \frac{2.5}{1.58 \times 1.58} = \frac{2.5}{2.49} = 1.004$

≈ 1

Thus, monotonicity is proved b/w X & Y.